WWF NZ Submission to Deepwater Group

Review of four orange roughy fisheries and issues preventing the fishery from meeting the Marine Stewardship Council (MSC) standard

21st of January 2014

Table of Contents

1. Executive Summary

WWF NZ conducted an analysis of four orange roughy fisheries put forward by the industry (Deepwater Group Ltd.) for MSC pre-assessment to ascertain the current health and status of the stocks, and to identify any issues that may prevent the fisheries from meeting the MSC standard.

In the course of the assessment five performance indicators (1.1.1, 1.1.2, 1.1.3, 1.2.4 (except MEC) and 2.2.1) were identified as having the potential to fall below SG 60 (which would lead to a failed assessment), while there were a further nine performance indicators (two in Principle 1 and seven in Principle 2) that would require conditions of certification.

Principle 1

WWF NZ believes that all roughy stocks are likely to be depleted below target levels, which would impair recruitment and therefore not meet the SG 60 scoring guidepost of the MSC standard.

The target levels currently set for the stocks (30% of B_0) are very low, especially for a long-lived species like orange roughy. In addition, the latest Harvest Strategy Standard document indicates that levels should be higher, a recommendation that has not been adopted.

There are an additional two performance indicators under Principle 1 that would likely lead to conditions for the stocks (PI 1.2.1 and 1.2.2).

Principle 2

WWF NZ believes that only one PI in principle 2 would not reach the SG 60 scoring guidepost as it is not possible to state that species of deepwater dogfish are likely to be within their biologically based limits, given their poor reproductive output.

There are other information gaps and some performance Indicators in Principle 2 that are likely to lead to a conditional pass. However, unlike in Principle 1, none of these information gaps would result in a score that would automatically fail the fishery.

The elements that would represent conditions of certification relate to the need for further or more complete information or evidence regarding environmental impacts, particularly related to impacts on the ecosystem or associated elements of bycatch, habitats or ETP species.

Where appropriate, results from this report are related to the pre-assessment of these fisheries conducted by MRAG Americas Ltd in December 2013.

The implementation of Fisheries Improvement Projects (FIPs) is discussed further in relation to any issues that may prevent the fishery from meeting the MSC standard.

2. Introduction

Orange Roughy is a commercially important species that was first introduced in to the Quota Management System in New Zealand in 1986. The species exhibits typical biological traits which are found in many deep-sea species; late to mature, slow growing, of low fecundity and prone to formation of dense aggregations for spawning and/or feeding. As a result they are relatively unproductive, highly vulnerable to over-fishing and potentially are slow to recover from the effects of over-exploitation. Roughy fisheries were heavily fished during the mid 80s and early 1990s and as a result several stocks in NZ waters are now severely depleted and in poor health.

Management of Orange Roughy stocks in the past has been poor, but since 2009 the New Zealand fishing industry, in particular the DWG (Deepwater Group), has invested heavily in research to assess the status of the stocks in a bid to rebuild these fisheries. In 2013 the industry advertised their intentions to put forward four Orange Roughy stocks (ORH MEC, ORH7A, ORH3B NWCR and ORH3B ESCR) through the Marine Stewardship Council (MSC) certification process.

Pre-assessment is the first formal stage of the MSC fishery assessment process and identifies the strengths and weaknesses of the fishery relative to the MSC assessment criteria. The main purpose of a pre-assessment is to obtain a clear understanding of the nature, scale, and intensity of a fishery and to identify any issues that may prevent the fishery from meeting the MSC standard. The results of the official pre-assessment were published in late December 2013 by MRAG Americas, and are referred to extensively throughout this document.

The purpose of this report is for WWF NZ to provide an independent analysis of the current health and status of the four Orange Roughy fisheries mentioned above. Evaluation results are interpreted in line with the MSC scoring guidelines for each Performance Indicator (PI) and where possible corresponding scores from the MRAG pre-assessment report are also mentioned. An additional section covers areas of concern on a more detailed perspective from attendance at the Deepwater Working Group meetings (DWWG) where data and stock assessment models are peer reviewed.

WWF recommends the development of a Fishery Improvement Projects (FIP) to address the issues preventing the orange roughy stocks from meeting the MSC standard. A FIP is defined as a multi-stakeholder effort to improve a fishery. FIPs are unique because they utilize the power of the private sector to incentivize positive changes in the fishery towards sustainability. FIP participants may include stakeholders such as producers, NGOs, fishery or aquaculture managers, government, and members of the supply chain. The ultimate goal of a FIP is to have the fishery performing at a level consistent with an unconditional pass of the MSC standard

3. Overview of the fisheries for certification

Four fishery management areas have been assessed during this limited Principle 1 and Principle 2 assessment (see below).
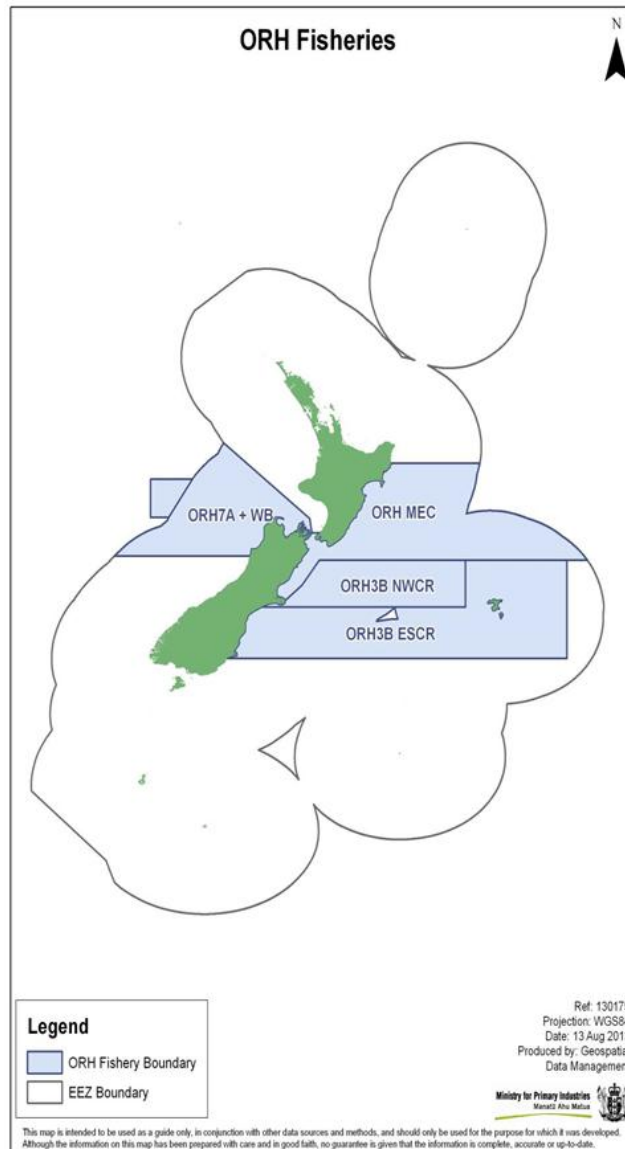
1. ORH MEC which incorporates the orange roughy ORH2A South, ORH2B and ORH3A quota management areas (QMA),
2. ORH7A, including Westpac Bank which is adjacent to and outside the EEZ. The Westpac Bank and ORH7A management areas are believed to include the same biological stock of orange roughy
3. ORH3B NWCR which is that part of the ORH3B QMA on the northwest Chatham Rise
4. ORH3B ESCR which is that part of the ORH3B QMA on the east and south Chatham Rise. This sub-stock has produced approximately 70% of the total catch from the whole of the ORH3B Quota Management Area.

4.   WWF Preliminary evaluation of the fishery

Principle	Component	PI	Performance Indicator	Likely scoring level			
				MEC	NWCR	ESCR	Challenger
1	Outcome	1.1.1	Stock status	🟥	🟥	🟥	🟥
		1.1.2	Reference points	🟥	🟥	🟥	🟥
		1.1.3	Stock rebuilding	🟥	🟥	🟥	🟥
	Management	1.2.1	Harvest Strategy	🟨	🟨	🟨	🟨
		1.2.2	Harvest control rules and tools	🟨	🟨	🟨	🟨
		1.2.3	Information and monitoring	🟩	🟩	🟩	🟩
		1.2.4	Assessment of stock status	🟩	🟥	🟥	🟥
2	Retained species	2.1.1	Outcome	🟩	🟩	🟩	🟩
		2.1.2	Management	🟩	🟩	🟩	🟩
		2.1.3	Information	🟩	🟩	🟩	🟩
	Bycatch species	2.2.1	Outcome	🟥	🟥	🟥	🟥
		2.2.2	Management	🟨	🟨	🟨	🟨
		2.2.3	Information	🟩	🟩	🟩	🟩
	ETP species	2.3.1	Outcome	🟨	🟨	🟨	🟨
		2.3.2	Management	🟨	🟨	🟨	🟨
		2.3.3	Information	🟨	🟨	🟨	🟨
	Habitats	2.4.1	Outcome	🟨	🟨	🟨	🟨
		2.4.2	Management	🟩	🟩	🟩	🟩
		2.4.3	Information	🟨	🟨	🟨	🟨
	Ecosystem	2.5.1	Outcome	🟩	🟩	🟩	🟩
		2.5.2	Management	🟩	🟩	🟩	🟩
		2.5.3	Information	🟨	🟨	🟨	🟨

Key to above table

High risk issue, leading to a fail score	**<60**
Medium risk, raising a condition	**60-79**
Low risk, leading to a pass	**≥80**

Please note the following sections will only focus on the areas which have scoring guidelines of <80.

5. Performance indicators below SG 60

5.1 Stock Status

ORH Mid-East Coast Stock (2A South, 2B, 3A)
The 2013 assessment base case estimated the stock to be at 24% B_0 (range 20-32%). It is unlikely to be above the target (at 30% B_0), as likely as not to be below the Soft Limit (20% B_0) and very unlikely to be below the Hard Limit (10% B_0).

Estimates of B_{MSY} are 23.1% of B_0 from the base case and 21.1% of B_0 for the Haist sensitivity (which estimates year-class strength differently). These estimates, however, are dependent on the assumed values of steepness in the stock-recruit relationship and, as the plenary report acknowledges, management targets need to be higher than these values, in part because of poor knowledge about the stock-recruit relationship. These values are also much lower than the proxies suggested in the Harvest Strategy Standard.

The fishery began in 1983-84 and has been operating for 30 years. For the mid-East Coast stock the age at maturity has been assumed to be the same as the age of vulnerability. The age at 50% vulnerability is estimated to be about 35 years but the estimate from the age-at-the-transition zone in otoliths is younger. This suggests that the effects of past fishing on recruitment, if not already evident, should soon be so. Recruitment has been also been estimated in the assessment to be well below average from the late 1980s through to the mid-1990s.

Given the above, it is quite plausible that the stock is below the point where recruitment would be impaired (though this is not well defined for orange roughy) and therefore WWF NZ believes it would not meet the SG 60 level. The fact that the Operational Guidelines for New Zealand's Harvest Strategy Standard recommends that proxies for B_{MSY} for very low productivity species such as orange roughy are ≥ 45% B_0 adds weight to that argument.

ORH3B North West Chatham Rise
The most recent assessment was in 2006. The biomass was projected to have declined from the 1980s to 2006 and to have reached 11% of unfished levels (95% confidence interval 8-16%). An alternative model produced even lower estimates of biomass.

Catch limits were reduced to 750 t in 2006 but, although the stock size was expected to increase over the next five years at this catch level, industry agreed to avoid fishing this stock in 2010/11, 2011/12 and 2012/13 to provide for more rapid rebuilding.

The current stock size is uncertain but it was estimated to be depleted to a level at which recruitment would have been impaired and it is plausible that the stock is still at a level where this remains the case. If so, WWF NZ believes the stock would not meet the SG 60 level.

The 2012 acoustic survey, however, has produced substantially higher estimates of stock biomass that are above the 30% B_0 target levels. These are yet to be accepted by the Deepwater Working Group as the best estimates of current biomass. If they are accepted, then this stock would meet all the requirements of the SG80 level.

East and South Chatham Rise (ORH3B)
This sub-stock has produced approximately 70% of the total catch from the whole of the ORH3B Quota Management Area. The most recent assessment was in 2013 when the biomass was estimated to be at 25%

of B_0 (range 19-32% B_0). The stock is considered unlikely to be above 30% B_0 (the biomass level that is used as a proxy for B_{MSY}). The stock was also considered unlikely to be below the soft limit of 20% B_0.

The discovery of a new West Spawning Site (also called the Rekohu spawning plume) has been taken as evidence that this sub-stock may be rebuilding. The new spawning site was about 25 nautical miles (about 44 km) further to the west, was in similar depths to the Spawning Plume, contained females that were on average 2cm larger than those in the Spawning Plume and had a slightly earlier but overlapping spawning period. There are, however, also doubts about the history of this plume the implications for stock projections are therefore also uncertain. There may be the potential for these fish to have been double counted in the acoustic surveys. Roughy can move about 10 km/day and surveys started 4 days apart.

Despite the stock being estimated to be above the soft limit, the uncertainty around the stock-recruitment relationship for orange roughy and the uncertainty of the significance of the new Rekohu spawning plume means that it is quite plausible that the stock has been fished down to below the point where recruitment would be impaired. In this case WWF NZ believes the stock would not meet the SG 60 level.

ORH7A, Challenger Plateau including Westpac Bank
The stock was assessed in 2013 and estimated to be 20 or 24% B_0. The stock is considered unlikely to be above 30% B_0 and as likely as not to be below the soft limit of 20% B_0.

Even if the stock is close to the soft limit, the uncertainty around the stock-recruit relationship for orange roughy means that it is quite plausible that the stock has been fished down to below the point where recruitment would be impaired and it's WWF NZ's opinion that the stock would therefore not meet the SG 60 level.

It is worth noting that the MRAG pre-assessment report for this performance indicator gives a conditional pass for the MEC stock (60-79) and states "no recent assessment" for the remaining three stocks, which it also grades as conditional passes by concluding "*although quantitative assessments based on fitting population dynamics models are not available for three out of the fours stocks, the information in the plenary report suggests that all four stocks are currently below 30%B_O and as such are not fluctuating around their target reference points*".

5.2   Reference Points

The same reference points are apparently used for all orange roughy stocks considered here so the score and the rationale are also the same.

a. Appropriateness of reference points
All the reference points are more than generic and are based on justifiable and reasonable practice. They would therefore meet the SG60 requirements. They can also be estimated and the type of reference points are appropriate for the stock, so WWF NZ believes they would meet the SG80 requirements.

b. Level of limit reference point
There are two types of limit reference points used: a 'soft' limit that is set at 20% of B_0 and a 'hard' limit that is set at 10% of B_0. The soft limit here is regarded as the limit reference point for the purposes of the assessment against the MSC standard.

Whether 20% of B_0 is above the level at which there is an appreciable risk of impairing reproductive capacity in orange roughy stocks is yet to be demonstrated, because of the short time over which stocks

have been fished relative to the species' longevity and the uncertainty about the stock-recruit relationship, making scoring of this issue problematic.

c. Level of target reference point

The management targets for orange roughy are 30% B_0 which is toward the lower end of the range of target biomass levels that are generally in use for teleosts. It is above the deterministic estimates of B_{MSY} that have been calculated for orange roughy but these are not robust (mainly because they are confounded with assumptions about the steepness of the stock-recruit relationship) and are not used. The justification for selecting this target is not clear but for one stock (ORH 7A) it is stated that B_{MSY} is interpreted as the mean biomass under a CAY policy which is estimated to be 30% B_0.

The Operational Guidelines for New Zealand's Harvest Strategy Standard recommends proxies for B_{MSY} for very low productivity species such as orange roughy of at least 45% B_0. This is well above the current management target.

It is not clear, therefore, that a stock that was maintained at this target reference point would be at a level that is consistent with B_{MSY} and therefore WWF NZ concludes that it is arguable that all orange roughy stocks would not meet either SG 60 or SG 80 on this PI.

d. Low trophic level target reference points

Orange roughy are not a LTL species.

It is important to note that the MRAG pre-assessment report refers to the limit reference point in b. as the "hard" limit i.e. 10%B_O but also scored all four fisheries as < 60 under this PI. It mentions "*additional justification of the reference points is needed to satisfy scoring issues b and c at SG60 and SG 80. There is great concern that the hard limit is below the MSC default level, and that there is no rationale given for why the current range (3-40% B_O) is an appropriate management target for Orange Roughy*".

5.3   Stock Rebuilding

All the orange roughy stocks considered here are estimated to be below target levels and have been for some time so they are 'depleted' in MSC language and require there to be a rebuilding strategy. For New Zealand's Harvest Strategy, however, stocks are only subject to formal rebuilding plans if they are estimated to be below the soft limit.

For this assessment against the MSC PIs, the combination of the formal rebuilding plans and the approach used for setting TACs for stocks that are not below the soft limit but are below target levels are considered together as representing the rebuilding strategy that is in place.

ORH Mid-East Coast Stock (2A South, 2B, 3A)
a. Rebuilding strategy design
It is not known whether the rebuilding plan that is in place for the mid-East Coast stock is considered to have a reasonable chance of success, therefore it's WWF NZ's opinion that this would not reach the SG60.

b. Rebuilding timeframes

According to the Operational Guidelines for New Zealand's Harvest Strategy Standard, rebuilding timeframes needed for formal rebuilding plans are based on the time it would take a stock to rebuild to target levels without any fishing (T_{min}) and allows rebuilding to take up to twice this duration.

From an MSC perspective rebuilding of all stocks to target levels must occur within 30 years but a single generation time of orange roughy is greater than 30 years.

Stock projections provided in the Plenary reports do not specify the estimated time to reach target levels and any such projections would be entirely dependent on the assumed levels of incoming recruitment. It is not clear, therefore, what levels of catch would still allow stocks to rebuild within the required timeframes making scoring of this issue problematic.

c. Rebuilding evaluation

There is monitoring in place that would allow the level of any rebuilding to be determined, so the SG60 requirements are met. Because rebuilding timeframes are expected to be decades long, frequent monitoring is not required.

For the mid-East Coast stock, the base case assessment indicates that recruitment has been low and the stock is not yet rebuilding so WWF NZ believes that this stock would not meet the SG80 requirements.

ORH3B North West Chatham Rise

a. Rebuilding strategy design

It is not known whether the rebuilding plan that is in place for the Northwest Chatham Rise stock is considered to have a reasonable chance of success therefore it's WWF NZ's opinion that this would not reach the SG60.

b. Rebuilding timeframes

As for the mid-East Coast stock, projections provided in the Plenary reports do not specify the estimated time to reach target levels making scoring of this issue problematic.

c. Rebuilding evaluation

There is monitoring in place that would allow the level of any rebuilding to be determined, so the SG60 requirements are met. Because rebuilding timeframes are expected to be decades long, frequent monitoring is not required.

For the Northwest Chatham Rise, the 2012 acoustic survey has provided biomass estimates that indicate that the stock is above the target reference point of 30% of B0. These have yet to be agreed by the Deepwater Working Group but they do provide evidence of rebuilding and WWF NZ believes that the stock would meet the requirements of the SG80 level.

East and South Chatham Rise (ORH3B)

a. Rebuilding strategy design

It is not known whether the rebuilding plan that is in place for the East and South Chatham Rise stock is considered to have a reasonable chance of success, therefore WWF NZ believes that this would not reach the SG60.

b. Rebuilding timeframes

As for the mid-East Coast stock, projections provided in the Plenary reports do not specify the estimated time to reach target levels making scoring of this issue problematic.

c. Rebuilding evaluation
There is monitoring in place that would allow the level of any rebuilding to be determined, so the SG60 requirements are met. Because rebuilding timeframes are expected to be decades long, frequent monitoring is not required.

There are alternative interpretations of the discovery of the new Rekohu spawning plume, making scoring of this issue as problematic.

ORH7A, Challenger Plateau including Westpac Bank
a. Rebuilding strategy design
It is not known whether the rebuilding plan that is in place for the Challenger Plateau stock is considered to have a reasonable chance of success, therefore it's WWF NZ's opinion that this would not reach the SG60.

b. Rebuilding timeframes
As for the mid-East Coast stock, projections provided in the Plenary reports do not specify the estimated time to reach target levels making scoring of this issue problematic.

c. Rebuilding evaluation
There is monitoring in place that would allow the level of any rebuilding to be determined, so the SG60 requirements are met. Because rebuilding timeframes are expected to be decades long, frequent monitoring is not required.

For the Challenger stock, a much higher proportion of newly recruited fish was found in the spawning population in 2009 than in 1987, but the mature biomass was assessed has having been relatively constant from 2009 to 2011. This would be unlikely, in WWF NZ's opinion, to meet the requirements of the SG80 level.

It should be noted that the MRAG pre-assessment report concluded that additional analyses were needed for this condition and therefore gave it a scoring guideline of <60 across all fisheries. It went on to state "*It is not clear that the proposed harvest control rule is consistent with the requirements of the MSC standard. In particular, there is no analysis which shows that the expected rebuilding time is 30 years (SG 60) or 20 years (SG80). Consequently, it is not possible to evaluate the fishery against scoring issues b and c*".

5.4   Assessment of stock status

The assessments of stock status vary among stocks and need to be assessed individually.

ORH Mid-East Coast Stock (2A South, 2B, 3A)
a. Appropriateness of assessment to stock under consideration
The assessment of the mid-East Coast stock is based on integrated age-structured model that takes into account the major features relevant to the biology of the species and the nature of the fishery. This meets the requirements of the SG100 level.

b. Assessment approach
The assessment estimates stock status relative to reference points and so meets the SG60 level requirements.

c. Uncertainty in the assessment
The assessment takes into account uncertainty and is evaluating stock status relative to reference points in a probabilistic way. MCMC runs for base case and a sensitivity were conducted and results used to provide probabilistic statements about stock status. This meets the requirements of the SG100 level.

d. Evaluation of assessment
The assessment has been tested and shown to be robust. A key alternative assessment approach has been rigorously explored and taken through to MCMC results stage. This would go close to meeting the requirements of the SG100 level.

e. Peer review of assessment
The assessment of stock status is at least subject to internal peer review through the plenary process. This meets the requirements of the SG80 level.

There are currently no recent stock assessment models for **ORH3B North West Chatham Rise**, **East and South Chatham Rise (ORH3B)**, and **ORH7A, Challenger Plateau including Westpac Bank** therefore it's WWF NZ's opinion that all these fisheries would fail at SG 60, point a.

The results from the MRAG pre-assessment report support the results from this study, also failing ORH 3B NWCR, ORH7A and ORH ESCR. It concludes "*Population model-based assessments either do not exist for the other stocks or are dated, and therefore would not be sufficient as the basis for satisfying PI 1.2.4*".

5.5   Bycatch species: outcome

For the purpose of this assessment and following the MSC guidance (GCB 3.8.2 CR v. 1.3, 2013) two species can be considered main bycatch species in the orange roughy fisheries (ORH3B ESCR, ORH3B NWCR, ORH7A, ORH MEC). Both Smooth skate (*Dipturus innominatus*) and deepwater dogfishes (spp.) are considered main bycatch species for the purpose of this assessment because there status is uncertain and at least the skate species is considered vulnerable to fishing due to its biology. The risks to the deepwater sharks are also recognized in the New Zealand National Plan of Action (NPOA) for the Conservation and Management of Sharks, with a range of measures to prevent and reduce potential impacts of fisheries on

shark species (Ministry of Fisheries 2008). From the document, however, it is not clear if these have been implemented.

Smooth skates are quota managed and because the catch in each of the management areas are negligible the risk from the orange roughy fishery is considered low and the fishery does not hinder recovery and rebuilding.

Nevertheless deepwater dogfish, in particular the shovelnose dogfish (*Deania calcea*) is caught in numbers that should be concerning for a species that has extremely low reproductive capacity and is not managed under the QMS. It is not clear whether deepwater dogfish are likely to be within biologically based limits, considering the lack of information on the biology and distribution of these fish. It is also not apparent that there are mitigation measures in place that are expected to ensure that the fishery does not hinder recovery and rebuilding.

For these reasons WWF NZ believes it is reasonable to assume that all four fisheries would fail this PI (SG<60).

The MRAG pre-assessment report gives this PI a condition (SG 70-79) and notes "*none of the bycatch species is actively managed, and are non-QMS. However, MPI can move those species into QMS for active management should problems occur*".

6.   Performance indicators with SG 60-79

6.1   Harvest Strategy

The same harvest strategy is used for all orange roughy stocks considered here so the score and the rationale are also the same.

There is little evidence that the harvest strategy used for these fisheries will achieve its stock management objectives and therefore WWF NZ believes that this would not meet SG80.

It is worth noting that the pre-assessment from MRAG also scores this PI with a condition noting that *"further justification for the orange roughy harvest strategy is needed to achieve a higher score"*.

6.2   Harvest Control Rules and Tools

The same harvest control rules are used for all orange roughy stocks considered here so the score and the rationale are also the same.

a. Harvest control rules design and application
The harvest control rules are well defined, are consistent with the harvest strategy and ensure that the exploitation rate is reduced as limit reference points are approached. This meets all the requirements of the SG100 level.

b. Harvest control rules account for uncertainty
Whilst the design of the harvest control rules take into account a wide range of uncertainties it is not understood if the selection of the harvest control rules take in to account the main uncertainties, therefore WWF NZ believes that this would not meet the requirement of SG80.

c. Harvest control rules evaluation
The available evidence does indicate that the tools in use are appropriate and effective in achieving the exploitation levels required under the harvest control rules. The evidence for this is necessarily much slower to accumulate for orange roughy than for species with younger ages to maturity and shorter longevity. Nevertheless, since the harvest strategy was originally adopted in 2008, there is evidence that it has led a cessation in the overfishing that depleted stocks of orange roughy and reduced exploitation levels to more sustainable levels. This meets the requirements of the SG80 level at least and could be considered to meet the SG100 level requirements.

The MRAG pre-assessment report also raises a condition for this PI, stating *"additional justification for all aspects of the harvest control rule is required"*.

6.3 Bycatch species: management strategy

Smooth skate (*Dipturus innominatus*) and deepwater dogfishes (spp.) are both considered main bycatch species for the purpose of this assessment because their status is uncertain. Smooth skate (*Dipturus innominatus*) are the only quota managed bycatch species. Therefore for this species there is a full strategy. However there is a question if the management arrangements for deepwater dogfishes are sufficient to maintain these species within biologically based limits and not hinder the recovery.

WWF NZ believes that this could lead to the fishery scoring below 80 and therefore having a condition assigned related to deepwater dogfishes (spp.).

The MRAG pre-assessment report also scores this PI as a conditional pass (60-79), and states "*although some measures are in place (eg. Catch data recording, observer data collection, data from trawl surveys) for non QMS species, this does not amount to a partial strategy, which would be resolved with introduction to the QMS system*".

6.4 ETP species: outcome status

Key legislation for ETP species includes the Fisheries Act (1996), Wildlife Act (1953), and Marine Mammals Protection Act (1978). There is a requirement to report injury or mortality of protected species to the Department of Conservation.

There are highly developed and active monitoring and observer programs on board trawler vessels; these provide a strategy to monitor the legislation. VMS is mandatory on ORH vessels

National Plans of Action have been developed for birds and sharks. An environmental risk assessment process has been completed for the fisheries (Boyd, 2013). The New Zealand Wildlife Act (1953) is administered by the Department of Conservation. No additional species are listed in CITES appendix 1 for the region.

Protected fishes: MPI Observer data (DWG and MPI 2013) and Conservation Services Programme reports (Rowe 2009, 2010; Ramm 2010, 2012a, 2012b), revealed that there has been no captures of oceanic whitetip shark, white pointer shark, whale shark, deepwater nurse shark, manta ray, spinetail devil ray, giant grouper or spotted black grouper (all protected under the Wildlife Act) in orange roughy fisheries. Observer reports on different types of interactions are specifically for seabirds (Ramm 2010, 2012) but the extent of indirect effects are less well known for these species. In addition in an assessment of the ecological effects of the New Zealand orange roughy fisheries, Boyd (2013) indicated that the knowledge of potential interactions of the fisheries with Basking shark (*Cetorhinus maximus*) could be improved.

Whale shark, manta ray, giant grouper and reptiles like marine turtles are tropical species and do not overlap with the four orange roughy fisheries.

Seabirds: Thompson & Berkenbusch (2013) provide estimates of seabird captures by orange roughy fishery for the past ten years, and Richard & Abraham (2013) which estimates the risk to New Zealand seabird species from all commercial fisheries. This is a 'Level 2' (semi-quantitative) risk assessment.

Boyd (2013) specifically considered Salvin's albatross, Chatham Island albatross and Northern giant petrel taking into account the two studies and determined that there is a high degree of certainty of actual mortalities due to the level of observer coverage and determined to be very low or negligible.

Maybe some higher resolution on species diversity is needed for the Northern giant petrel to confirm actual captured and mortalities by species.

Corals: Black corals - all species in the order Antipatharia, Gorgonian corals—all species in the order Gorgonacea, Stony corals— all species in the order Scleractinia, Hydrocorals are protected. The process of mapping the distribution of cold water corals area has been undertaken across the New Zealand EEZ. In addition there is good information a good information base from NIWA research, including dredge samples and video (Boyd, 2013). However much of the information of the corals is based on trawl net captures which has limitations. In addition taxonomic information is limited at the species level.

Marine mammals:

All marine mammals are protected. There are no records of New Zealand fur seals, New Zealand sea lions, dolphin or whale species in the four orange roughy fisheries (Thompson & Berkenbusch 2013). The fisheries operate in areas where no sea lions are present.

While the observer records do not provide complete coverage of the fishery and it varies between management areas, the infrequent encounters of ETP species in general, combined with the fisheries footprint suggest that it is highly unlikely to create unacceptable impacts.

WWF NZ believes that the uncertainty of indirect effects (especially with regards to the corals) would give this PI a conditional pass (60-79) for this assessment.

The MRAG pre-assessment reports also scores this PI as a conditional pass stating "*In most cases (fish, seabirds, sharks, and marine mammals) direct and indirect effects of the orange roughy fishery are minimal and highly unlikely to create unacceptable impacts.*
However, the direct and indirect impacts on coral are less certain, as the extent to which trawling might be linked to impaired benthic ecosystem functioning has yet to be determined. It is not clear that sufficient analysis has occurred to demonstrate that the fisheries are highly unlikely to have unacceptable direct and indirect impacts for deep sea corals.

The fishery continues to add new areas of trawling, although at a declining level. If protected corals are impacted, or may be impacted to any significant extent, then there is a need to define the level of that impact, including adequate identification, quantity taken and distribution of the corals".

6.5   ETP species: management strategy

Key legislation for ETP species includes the Fisheries Act (1996), Wildlife Act (1953), Marine Mammals Protection Act (1978), There is a requirement to report injury or mortality of protected species to the Department of Conservation.

There are highly developed and active monitoring and observer programs on board trawler vessels; these provide a strategy to monitor the legislation. VMS is mandatory on ORH vessels

National Plans of Action have been developed for birds and sharks. An environmental risk assessment process has been completed (Boyd, 2013).

It is not clear, however, that the impact on deepwater corals is likely to achieve national and international requirements for the protection of ETP species, therefore WWF NZ believes that this would raise a condition (SG 60-79) under this PI.

The MRAG pre-assessment agrees with this scoring and also notes *"There is monitoring of the trawl footprint on an annual basis through mandatory reporting and VMS and this information is used to analyse the nature and extent of trawl footprint against habitat area and some regional assessments. In addition benthic interactions are measured and recorded by on board fisheries observers. Together these measures provide some understanding of the nature and extent of impacts. But the fishery continues to expand to new areas (although at a declining rate). Orange roughy tows appear to follow existing tow lines, but by practice, not requirement. It is unclear that a strategy is in place to minimise coral mortality, especially with the possibility of expansion of the trawl area from the fishery, and if the measures follow the approach outlined by the Ministry for Primary Industries leading to appropriate management strategies. Evaluation of whether there is a need to reduce expansion of the fisheries to new trawling areas, and if so, how that would happen would benefit the management of corals".*

6.6   ETP species: information

Monitoring seabird and marine mammal mortality within the fishery is a specific role of the observer on board vessels. The coverage of observers has been sufficient to develop reasonable estimates of the likely total mortality of seabirds in each fishery and area.

Higher species resolution would also be advisable for the Northern giant petrel to confirm actual captured and mortalities by species.

Cold water corals captured in trawl nets are noted by observers present onboard, but species identification remains a problem with information on distribution largely based on trawl capture. With this in mind WWF NZ believes that points b. and c. would not pass the SG80.

The MRAG report concurs with theses results and adds "at present *data are insufficient to quantitatively determine outcomes for deepwater corals"*.

6.7   Habitats: outcome

Bottom trawls in the New Zealand orange roughy fishery are primarily deployed along a single type of benthic habitat: undersea topographic features (UTFs) (Boyd 2013). Habitat-forming deepwater corals, many species of which are protected (see section on ETP), form on these topographic features.

Stewart (2013) and Clark (2013) presented assessments of the trawl footprint. Even though studies used differences time scale and depth data, results indicated that the area impacted was small in relation to total habitat and therefore it is unlikely that the fishery will reduce habitat structure and function to a point where there would be serious or irreversible harm. In addition, the EEZ and Territorial Sea (TS) annual trawl footprint for orange roughy reached a peak in 1998/99 at around 7,200 km^2, after which it steadily decreased, by almost two-thirds, to around 2,500 km^2 in 2009/10 (Tilney 2013).

Boyd (2013) noted, however, a lack of detailed information on structure and function of the habitat and description of the composition of communities in the fishery and therefore it is WWF NZ''s opinion that it is difficult to state that the fishery is highly unlikely to reduce habitat structure.

The MRAG report reaches the same conclusion for this PI and states *"analysis of the distribution of benthic habitats relative to the footprint of the fisheries would increase understanding of the impacts of the four fisheries being assessed"*.

6.8   Habitats: information

Observer coverage and VMS has been sufficient to develop reasonable estimates on trawl footprint in each fishery and area.

Cold water corals captured in trawl nets are noted by observers present onboard, but species identification has been identified as a problem. However a mapping study of the entire EEZ is underway and may even be completed. Boyd (2013) also noted a lack of detailed information on structure and function of the habitat and description of the species composition of habitat communities in the fishery.

Information is adequate to allow the nature of the impacts of the fishery on habitat to be identified and reliable on the spatial extent of interaction, and the timing and location of use of the fishing gear. However, the nature, distribution and vulnerability of all habitat types in the fishery area are not known in detail and therefore WWF NZ believes that this PI would be given a conditional pass (60-79) for this reason.

6.9   Ecosystem: information

Key elements of the ecosystem such as prey and predators of the target species are quite well known and components and characteristics of the ecosystem are largely described (Dunn 2013) to **broadly** understand the key elements of the ecosystem.

Pinkerton (2011) provides a balanced trophic model of the Chatham Rise ecosystem with focus of the model on the role of demersal fishes resulting in a better knowledge base of the Chatham Rise fishery.

Dunn (2013) indicated that research on the biodiversity of the ecosystem for all management areas and monitoring of the identified functional groups or species that are linked to the dynamics and maintenance of ecosystem function would be desirable. This would allow detection of any increase in risk of interrupting the ecosystem structure and function or the operation of the fishery as well as the effectiveness of its measures.

Nevertheless, because the history of the orange roughy fishery in New Zealand is relatively short compared to the unusually long generation time of the species, assessments of **long term** impacts of removals on the broader ecosystem may be difficult and misleading at this time and therefore WWF NZ believes it is reasonable to suggest that this condition would score a conditional pass (60-79).

7.   Other issues and concerns

Whilst the main emphasis of this report is to highlight concerns that are reflected in the evaluation results (scoring guidelines), it is important to also mention areas of concern that concentrate on how the data is collected, how it is interpreted and ultimatley the quality of the assessments that are the main feature of the plenary documents for these fisheries. Much of this information is omitted from official documents, but yet is deserves equal attention with regards to the assessment of the fisheries in question.

7.1   Data defeciency on the biology of Orange Roughy

Most biological data for orange roughy are historical, and then assumed to be constant. Information about the stock structure and migrations of orange roughy is still relatively poor. For example, the "new" Rekohu plume in ORH3B was found only a few years ago, and about 50 km from the spawning plume in the Spawning Box. How independent these areas are is not known. The origin and affiliation of the Rekohu plume is also not known (historical research indicate fish from the main plume migrated east towards the non-spawning fishery region after the breeding season; no information on movements of the Rekohu fish is available).

Ageing of orange roughy in the past has been highly problematic, to the extent that all age data (although not information derived from these data, such as growth, maturity, and longevity) were excluded a few years ago. Whilst ageing work is continuing, the uncertainly in age estimates remain high and this remains a concern for stock assessments.

7.2   Data collection

Some areas, like ORH1, are enormously data deficient. It seems that problems occur when surveys are done by commercial fishing vessels, as they conduct research in between their commercial operations but the latter take precedence and may compromise research work. In addition, the crew may not follow the sampling methodology correctly, for example not switching equipment on when they should (2013 surveys in ORH1).

The location and/or timing of the surveys also seem to be questionable, with several instances showing that fish were present in low numbers at the time of data collection. Yet skippers from commercial boats in the same area report large numbers just prior to or after the research survey. As a result several areas, including ORH1 and the subantarctic area of ORH3B, do not have the most basic biomass monitoring data sets.

When orange roughy are not found during a survey, it has often been thought that the survey was in the wrong place and/or the wrong time. In some areas, for example Mercury-Colville in ORH1, the original orange roughy fisheries were temporally and spatially expansive, and therefore the apparent scarcity of fish in recent years does tend to indicate the stock remains substantially depleted, rather than it was simply "missed" by the survey. The precautionary approach suggests managers setting catch limits should assume biomass to be absent until proven. The ORH1 area is a real challenge for the assessments, as the biomass surveys to date have not been accepted, and therefore no data are available to evaluate the catch limits.

7.3   Interpretation of results

Previous surveys have used trawls, acoustics, and egg surveys, and all have experienced problems and data collection has been varied and fragmentary.

The primary technique currently being used for tracking stock biomass is acoustic surveys. Recent surveys have generally used the echosounder on the hull of a fishing vessel, or the towed Acoustic Optional System (AOS). The AOS, recently purchased by Sealord and previously developed and used by CSIRO to estimate fish acoustic target strengths, has now been used to provide biomass estimates. However Rudy Kloser, the scientist leading the use of this technology, has stated recently that problems (listed below) exist in several areas of the interpretation, and his research team continue to work on sources of error and bias in estimates. In some areas (such as the Morgue seamount, NZ) he concluded that it is very hard to get an acceptable biomass estimate of orange roughy from AOS surveys, due to slope of hill.

Mixed species in aggregations still prove to be a big problem, with recent data showing that deep water sharks have similar target strengths to orange roughy and as a result the two fish are difficult to tell apart. There are also still "unknown" species in some areas (i.e., not orange roughy, but exactly what isn't known). For such areas, it is very difficult to decompose the acoustic "mark" into biomass of different species. The biomass estimates of orange roughy are also very sensitive to the proportion of gas bladder species, so small errors in the estimated species composition could have large effects on the biomass estimates.

A second main issue affecting biomass estimates is the correction made for fish in the acoustic "deadzone". The deadzone area can encompass the 5-50+ m of water depth above the seabed which cannot be seen because of interference from acoustic backscatter off the seabed. On a flat seabed the deadzone is minimal (a few m), but on sloping areas (e.g., hills) the deadzone can become very large (the greater the angle of slope, the greater the deadzone). A correction is currently made for orange roughy present in the deadzone, but whilst evidence suggests fish are there, in some surveys the proportion assumed in the deadzone is actually greater than the observed biomass. In other words, most of the biomass in the biomass estimate was never actually seen, it was just assumed. The deadzone is reduced when the acoustic device is closer to the fish, but if it gets too close it spooks the fish, and on hills a substantial deadzone nevertheless remains (eg. the Morgue seamount).

A third major issue for acoustic surveys concerns the variability in biomass estimates over space and time, and what these may mean. The acoustic estimates sometimes vary by an order of magnitude over short time periods, suggesting fish are moving (a problem for any survey), or that confidence in the acoustic survey technique and estimates may be misplaced. Understanding what the fish are doing seems to be a major challenge, and whilst new technologies are being used, they have only provided a glimpse into the problem, and remain far from tractable solutions.

7.4   Stock assessment models

Patrick Cordue (Innovations Ltd) has been assigned to compile current stock assessments for the four orange roughy fisheries that are reviewed in this report. Whilst progress has been adequate with models created for certain stocks (e.g. MEC), there are still substantial issues with the stock assessment models.

Biomass estimates

In models presented to date, the main information on stock biomass seems to be coming not from the biomass surveys, but from the age data. This is concerning because it is doubtful how much information the age structure of the stock (the Year Class Strengths, YCS) would actually have about biomass. The Deepwater Working Group rejected the use of YCS data several years ago because of their uncertainty (mainly related to the accuracy of the way otoliths were being interpreted), so it is worrying that these data are now become central to determining the size and status of the stocks.

In addition, what biomass data that will be used in future stock assessment models will be taken from acoustic surveys (using the AOS device), and the problems with quality of these data have already been discussed.

Finally, there seems an "urgency" to get the available data to fit the models, and as a result assumptions have been made and accepted that were apparently argued about and ultimately rejected years ago by the Deepwater Working Group. There seems to be little discussion or justification for why such assumptions are now accepted. For example, the plume biomass survey was taken for many years as an indicator of spawning stock biomass, but this has now been rejected. This seems to be because it conflicts with the biomass estimates when the Rekohu plume is included, and when interpreted by a model. But if there is a conflict between data series (as it seems there is here), a better approach may be to treat them as two different indices, rather than effectively modify one index so that it fits the other. At the very least, the support for the assumption needs to be clearly stated.

Model predictions

There are so many unknown effects that are yet to be observed following the dramatic fishing down of orange roughy stocks in the late 1980s and early 1990s, owing to the fact that roughy take 30 years or more to mature. It is possible that recruitment to the fishery may have been dramatically affected by the fishing in the 1980s, but with such late recruitment we will not see this for another 5-10 years. If the fishing down substantially reduced recruitment, then we should expect a period of low recruitment or recruitment failure to arrive in the near future. In cases where the stock is supposed to be recovering, this will at best stop the recovery, and probably the stock would go into decline again. This may make stock rebuilding targets effectively impossible for the foreseeable future.

The models are extreme simplifications of reality, in that they have only one sex, one area, assume complete mixing of individuals, and the biology does not change over time. The models do not allow for changes in the natural environment, or changes brought about by fishing (such as disturbance, habitat changes, and the influences these may have on productivity). The models don't account for these things, and therefore the real uncertainty in the science is greater than it appears in the results from stock assessments.

We do not know what the structure of the stocks currently are, but changes in the size of spawning fish in some areas, and in particular in the main location of spawning, shows stock structure is not the same now as it was in the past. This poses questions as to how similar the stock productivity will be in the future as it was in the past. The models used are naïve to this.

8.   Fisheries Improvement Projects

Results from the WWF NZ and the MRAG pre-assessment report have indicated several key areas of concern with the four proposed orange roughy fisheries that would prevent them from reaching Marine stewardship council standard, the majority of which are concerned with Principle 1: stock status and management.

In early January 2013, WWF NZ received an email from the Deepwater Group (DWG) inviting them to attend a consultation meeting on the 21st of January to discuss the results of the MRAG report and the plan proceeding forward for the four orange roughy fisheries.

WWF NZ welcomes open and constructive dialogue with the industry and relevant stakeholders to address the issues that need improvement. The recognised vehicle for this is a formal Fisheries Improvement Project (FIP).

A FIP is defined as a multi-stakeholder effort to improve a fishery. FIPs are unique because they utilize the power of the private sector to incentivize positive changes in the fishery towards sustainability. FIP participants may include stakeholders such as producers, NGOs, fishery or aquaculture managers, government, and members of the supply chain. The ultimate goal of a FIP is to have the fishery performing at a level consistent with an unconditional pass of the Marine Stewardship Council (MSC) standard.

A FIP involves three stages:
(1)   Scoping: Identify all stakeholders and agree on the environmental issues that need to be addressed by the project.
(2)   Action Planning: Bring together all stakeholders to develop a plan to transition the fishery to the required standards; and
(3)   Implementation: Implement the plan and report on its progress.

It would be the intention of WWF NZ to suggest that a scientific workshop meeting is convened before stage (1) to address the unique issues with orange roughy fisheries that are concerned with stock status and management to provide the best and most robust FIP plan.

WWF NZ welcomes the input and views from the Deepwater group on these points and hopes to continue dialogue in this area to address these concerns.

9.   List of Acronyms

B_0	Unfished Biomass
B_{curr}	Current Biomass
B_{targ}	Target Biomass
B_{msy}	Biomass at Maximum Sustainable Yield
CAY	constant annual yield
CITES	Convention on International Trade in Endangered Species
cm	centimeter
CPUE	catch per unit effort
CR	certification requirement or Chatham Rise
DWG	Deepwater Group
EEZ	exclusive economic zone
ETP	Endangered Threatened or Protected
$F_{\%SPR}$	Fishing Mortality Rates at Maximum Spawning Potential Ratio
F_{MSY}	Fishing Mortality at Maximum Sustainable Yield
kg	kilogram
km	kilometer
LTL	low trophic level
m	meter
M	natural mortality
mm	millimeter
MPI	Ministry for Primary Industries
MSC	Marine Stewardship Council
NIWA	National Institute of Water and Atmospheric Research
NPOA	National Plan of Action
ORH	Orange Roughy
PI	performance indicator
QMS	Quota Management System
RBF	risk based framework
SG	Scoring Guidepost
SL	standard length
t	tonne
TAC	total allowable catch
TACC	total allowable commercial catch
T_{min}	Minimum time period
UTF	underwater topographic feature
VMS	vessel monitoring system
WWF	World Wildlife Fund

10.   References

Boyd, R.O. 2013. Assessment of Ecological Effects of Four New Zealand Orange Roughy Fisheries. Report for Deepwater Group Limited. Boyd Consulting, New Zealand. 39 p.

Clark, M. and Anderson, O. 2013. Information on the Structure and Function of UTF Habitats. NIWA. 54 p.

Dunn, M. 2013 Ecosystem Impacts of Orange Roughy Fisheries. School of Biological Sciences Victoria, University of Wellington, New Zealand. 17 p.

Ministry for Primary Industries. 2013. Fisheries Assessment Plenary, May 2013: stock assessments and yield estimates. Compiled by the Fisheries Science Group, Ministry for Primary Industries, Wellington, New Zealand. 1357 p.

Deepwater Group and Ministry for Primary Resources. 2013. Orange Roughy Fishery Observer Programme Report 2007-08 to 2011-12. 77 p.

Pinkerton, M.H. 2011. A Balanced Trophic Model of the Chatham Rise, New Zealand. NIWA, New Zealand. 60 p. Available at: http://www.niwa.co.nz/sites/default/files/chatham-model_32.pdf

Ramm, K. 2010. Conservation Services Programme Observer Report: 1 July 2008 to 30 June 2009. Department of Conservation. 126 p.

Ramm, K. 2012a. Conservation Services Programme Observer Report: 1 July 2009 to 30 June 2010. Department of Conservation. 130 p.

Ramm, K. 2012b. Conservation Services Programme Observer Report: 1 July 2010 to 30 June 2011. Department of Conservation. 121 p.

Richard, Y. and Abraham, E.R. 2013. Risk of Commercial fisheries to New Zealand Seabird Populations. New Zealand Aquatic Environment Biodiversity Report No 109. Ministry for Primary Industries, New Zealand. 62 p.

Rowe, S.J. 2009. Conservation Services Programme Observer Report: 1 July 2004 to 30 June 2007. Department of Conservation. 94 p.

Stewart, 2013. CR2013/190LR Analysis of Orange Roughy Trawl Footprint 2007/08 –2011/12 and 1989/90 –2011/12, and Underwater Topographic Feature Trawl Effort Analysis. GNS Science. 32 p.

Tilney, R. 2013. Management of Benthic Effects by New Zealand's Orange Roughy Fisheries. 8 p

Thompson, F.N. and Berkenbusch, K. 2013. Protected Species Bycatch in Orange Roughy Trawl Fisheries, 2002-03 to 2011-12. Draft Final Research Report for Ministry for Primary Industries (Unpublished report held by the Ministry for Primary Industries, Wellington). 56 p.